15000 – MECHANICAL/PLUMBING

DESIGN

A. General

1. Where building size and use require complex multi-zone comfort systems, central plant configurations are preferred. In such cases, the basis of the heating and cooling system should be centrifugal chillers above 120 tons and reciprocating type below 120 tons supplying chilled water to V.A.V. air handling units. A four-pipe system should be used. Firetube hot water boilers supplying hot water to perimeter baseboard or VAV terminal mounted heaters and air handlers (morning warm-up) should be used for the heating system. Temperature controlling system should be electronic (DDC) with differential enthalpy controlled economizer, night set back and morning warm-up functions. Chillers should be located in an enclosed mechanical room. Provide refrigerant monitoring, detection, alarms, and ventilation as required to meet Mechanical Code requirements and ASHRAE standards.

2. In small, less complex buildings, roof top units with natural gas heat (where available) and DX cooling are preferred

3. Where gas is not available, packaged air to air heat pump units with 100% electric back up are acceptable. In all cases, condensate piping shall be provided to a storm drain or directly outside; and the piping securely anchored to the floor.

4. The Architect shall send building load letters to the electric and gas companies at appropriate times during design.

5. The HVAC system shall meet all building code requirements for heating and cooling loads. In addition, the code requirements the HVAC designer shall pay close attention to anticipated actual building loads to ensure that the system efficiently meets these requirements. Fairfax County has had problems with systems that meet the code requirements but do not effectively heat, cool or dehumidify the building in actual loading conditions. Descant humidifiers should be considered for all systems that introduce large quantities of outside air into an occupied space. Building envelope components shall be designed for energy efficiency in compliance with ASHRAE, BOCA Mechanical and other applicable building and energy codes.

6. Architect shall submit cut sheets for the major equipment pieces which form the basis for design at the Design Development stage. The cut sheets must identify equipment dimensions, and the Architect shall provide detailed plan and section views (1/4" = 1' or larger scale) dimensioned to show the major equipment, duct work and piping located at mechanical spaces. Detail plans must reflect that adequate space and clearances are provided for inspection, maintenance and replacement access, and all major mechanical equipment.

7. Provide sanitary sewer clean-outs at each end of building at main sanitary sewer trunk lines.

8. The Architect shall coordinate with the Project Manager and Facilities Management Division prior to selection of the mechanical system.

9. Architect shall conduct a life-cycle cost analysis for a minimum of two alternate mechanical system options during the Schematic/Design Development phase.

10. The Architect shall retain an independent HVAC Commissioning Agent to review mechanical plans and specifications and to conduct commissioning of HVAC systems in the heating and cooling modes.

B. Heating and Cooling

1. Systems designed should maintain the following temperature settings.

	OCCUPIED	UNOCCUPIED
General Office Space Heating	72°F	55°F
General Office Space Cooling	76°F	85°F
Warehouses/Garages/Apparatus	60°F	N/A

2. Outside Air Design Parameters (temperatures) for General Building Areas.

Winter 14°F
Summer 91/74°F

Verify design temperatures with ASHRAE Standards.

3. Strong consideration should be given to energy conservation, life cycle cost analysis of alternate systems shall be performed.

4. Warehouses, garages and Fire Station Apparatus Bays should be provided with infrared tube heating systems and should not be air-conditioned. All systems should include economizers for "free cooling" during the intermediate seasons.

5. The building thermal envelope should as a minimum be designed as follows:

Window U-Factor	0.50 Maximum
Average Wall U-Factor	0.1 Maximum
Soffit/Floors U-Factor	0.10 Maximum
Roof U-Factor	0.05 Maximum
	0.10 Maximum in storage/equipment room

6. Provide HVAC zones for different functional areas and to allow for night use in appropriate areas.

7. Where design loads for a space my vary significantly from actual, normal loads, the system shall be designed with capacity reduction capability.

C. Mechanical Specifications Requirements

Regarding the mechanical system, the following criteria should be included in the specifications:

1. Boilers - The specifications should include:

   a. Outside Air Reset - outside air reset of system supply water temperature should be provided via dual-bulb electric or pneumatic aquastat controller rather than 3-way bypass valve with single-bulb boiler aquastat. The main concern is maintaining a constant temperature inside the boiler to reduce wear caused be expansion, contraction, and condensation.

   b. Combustion Efficiency Test - Burner should be tuned up for maximum performance, including correct nozzle size, flame shape, and air damper adjustment for minimum excess air. Performance should be verified via written results of an instrumented combustion efficiency test, including test data net stack temperature, percentage C02 or 02 oil smoke spot or percentage C0, and total combustion efficiency percentage.

2. Where removable printed circuit boards are provided, an extra set should be furnished including description, manufacturer, and source of supply identified.

3. Provide spare relays for A/C units plus name of manufacturer, and source of supply (include in Maintenance Manual).

4. Provide one extra set of belts for each belt driven unit.

5. Provide two extra changes for each type filter. 2" pleated are preferred. Install new filters at Substantial Completion in addition to the two spare sets.

6. Provide proper set of any non-standard test tools/equipment and appropriate training for installed equipment. Be specific. If possible, avoid specifying non-standard test tools/equipment.

7. The temperature control system and the energy management control system shall be provided by one manufacturer.

8. An instructional session shall be held after systems are functional to familiarize Fairfax County staff (FMD) mechanics with the design and construction of the system. Time shall be set up during the warranty period for "shake down" meetings as needed. Total instructional and "shake down" time provided by the design engineer and installing Contractor shall be coordinated with the Owner prior to bidding but shall not be less than twelve hours. Contractor shall video tape all instructional sessions and provide the videotape to the Owner.

9. Maintenance needs and responsibility should be clearly defined before the system is accepted by Fairfax County. The specifications shall provide for a two-year maintenance and warranty period for all HVAC systems and associated controls. Requirements of this extended warranty period must be defined during design and specifications development process.

10. If roof mounted A/C units are used, provide a power receptacle, an interior stepladder with hand rails, steps 12" apart and top step no more than 15" from opening up of roof hatch. Roof walkways must be provided in all expected travel areas and around roof top units. Provide platforms around HVAC units elevated above roof surface. Ladders must be provided to all roof levels.

11. Mechanical equipment rooms located on the ground floor and roof shall be accessible from outside the building and shall be provided with double doors. Paved access for maintenance vehicles shall be as close as possible. Equipment rooms must be weatherproofed and have secure locking hardware.

12. Provide wall mounted (framed and covered with Plexiglas) control diagrams in all boiler and mechanical rooms. Diagrams shall show, as a minimum, all equipment and controls in that room, temperature pressure and flow rate operating and limit values, as well as any applicable electrical schematics.

13. All valves shall be numbered with brass tags and referenced to operational instructions.

14. Provisions shall be made for metering of heating fuel oil consumption. Provide back flow preventers in fuel lines, as required. Exposed exterior fuel lines must be insulated/heated.

15. Facilities Management Division (FMD) staff shall also be notified when system balancing is scheduled so HVAC mechanics can observe the procedure.

16. Access panels or doors must be provided for any equipment located in all wall or ceiling spaces that may require maintenance, repairs, or modifications.

17. All equipment, smoke detectors, heat detectors, etc., which are located above a suspended ceiling must be clearly labeled at the appropriate location on the ceiling.

18. Centrifugal type chillers shall be specified to operate using R-123 or R-134A refrigerant.

19. All motors are to be high efficiency type.

20. A minimum of three-foot clearance is required at electrical elements at VAV boxes, fan coil units, etc. per National Electric Code (NEC.)

21. Refer to the Mechanical Code for requirements to provide guardrails at the edge of roof areas adjacent to rooftop equipment that will require maintenance access at the roof level.

22. No plumbing piping is to be installed over top of electrical panels or equipment, unless in compliance with NEC limitations.

23. Provide water source near outside and rooftop mechanical equipment. Water spigot at exterior of building shall be designed to limit access to authorized personnel. (Keyed spigots)

24. Domestic water supply for the cooling tower and any irrigation system shall be sub-metered to reduce monthly sanitary sewer costs.

25. Infrared sensors are not to be specified for use in automatically activating lavatories, urinals or water closets. All of these fixtures are to be manually operated.

D. Insulation

1. All ductwork and piping that will lose energy to or gain energy from the surrounding atmosphere or may cause condensation problems should be properly insulated to minimize energy costs and condensation problems. All roof drain piping shall be insulated.

2. Electric heat trace, tape system shall be provided for exposed exterior fuel oil lines; but shall not be specified for hot water system.

E. Energy Management and Control Systems

1. In all buildings, an energy management and control system (EMCS) shall be installed.

2. The energy management and control system shall monitor and control HVAC operations and conditions, alarm abnormal conditions and index control modes and provide AHU optimized start/stop operations, and provide reporting and trend logs. The specific system requirements shall be reviewed with the Project Manager during design.

3. The plans and specifications for the EMCS must include a detailed points list showing all monitor and control points and identify all required software and hardware.

4. The EMCS must be capable to perform the following functions:

Monitor and Alarm Selected Conditions: Temperature; Pressure; Flow; On/Off, Start/Stop Status; Safety Control Status (Fire, Freeze, Smoke).
Initiate Selected Control Sequences:
AHU/Chiller/boiler/pump; Start/Stop; Occupied/unoccupied modes; Optimized Equipment Start/Stop operation. (it shall not duty cycle VAV air handling units).

5. The EMCS should not be directly involved in the local loop controls, and the local loops shall continue to operate if the EMCS fails.

6. All EMCS components shall have surge suppression devices and battery backup. Central computer system shall have uninterruptable power system. A central control keypad and computer interface port shall be provided at the

building maintenance office for controlling the EMCS system; unless otherwise directed by DPWES.

7. The EMCS must be capable of alarming to, and be communicated and programmed by any compatible personal computer via modem. EMCS shall be expandable and be compatible with the electronic equipment controls. EMCS must have a security password/code for system entry and programming. A telephone jack shall be provided for modem installation.

8. A personal computer with graphics, internal modem and printer shall be located in a securable room located near or within the mechanical room. Remote processing units shall be capable of communicating with the local terminal. Provide two copies of the EMCS software; one for onsite use and one for FMD's central monitoring/control station.

F. Fire Protection

1. Sprinkler System to be designed, installed, and tested in accordance with all applicable codes and reviewed and approved by local authorities having jurisdiction. Contractor is responsible for all shop drawing review fees and permit fees charged by the Fire Marshal's office.

   a. Sprinkler piping is not to be routed over top of electrical panels or equipment, except as specifically permitted by NEC.

   b. The inspectors test valve shall be located in a readily accessible location. This is essential to minimize the impact to the user agencies during the cyclic testing. Provisions for discharging the water during the cyclic system test shall be made by piping the drain to the exterior of the building. The use of buckets for cyclic testing is not acceptable.

   c. Sprinkler devices, valves, etc., shall be permanently tagged noting the device and its purpose. Valves or devices that are located above accessible ceilings should be marked at the ceiling level indicating a device or valve above.

   d. The use of McDonnell & Miller flow switches for the sprinkler system is unacceptable. These are not rated for use with fire alarm systems.

   e. Do not specify Central Omega sprinkler heads for use on any Fairfax County project without prior, written approval from the Fairfax County Fire Marshall.

   f. Dry sprinkler valves shall be installed so that a proper test, reset, and maintenance can be performed from one location. Use of dry type sprinkler systems is discouraged due to maintenance requirements.

      Pressure gauges, drains and valves shall be installed as required to accomplish this.

   g. Specifications shall require contractor to provide attic stock sprinkler heads and spare sprinkler head wenches.

G. Commissioning

1. Requirements for an HVAC system commissioning process shall be included in the scope of work for the Architect, Mechanical Engineer, and the construction contract. An independent Commissioning Authority may be hired by the Owner or the Mechanical Engineer may be responsible for the Commissioning work. The ASHRAE standard guidelines for commissioning shall serve as the basis for all HVAC commissioning and the guidelines will be tailored to the specific requirements of the project.

2. The Architect and Mechanical Engineer will perform reviews of the HVAC system design from a commissioning perspective at all review phases of the design process, and will cooperate fully with the Owner's Commissioning Authority throughout the design review process as applicable.

3. The contract specifications must clearly spell out the responsibilities of the General Contractor and all appropriate subcontractors relative to commissioning, and shall also define the role of the Commissioning Authority.

4. The Architect and Mechanical Engineer will coordinate and cooperate fully with the Owner's Commissioning Agent and with DPWES representatives throughout the actual HVAC system commissioning process prior to and subsequent to system acceptance. The Architect and Mechanical Engineer will provide all design and or system information that is requested by the commissioning team members and will respond to all comments from the Commissioning Authority from design through system acceptance.

PRODUCTS

A. Mechanical Equipment Preferences

Below are listed recommended equipment brands for which supply of repair parts exist:

Chillers:	Trane centrifugal Trane reciprocating with air-cooled condenser
Cooling Towers/Pumps:	Baltimore Aircoil, Bell, Gossett Series, 1510 Evapsco
Boilers:	Cleaver Brooks horizontal firetube comb. Natural gas/#2 oil Fired Burnham 4F
Air Handlers:	Trane, inlet vane or variable frequency drive VAV with 100% O.A. capability and low leakage dampers.
VAV Boxes:	Titus, Trane Electronically controlled
Electronic System:	1. Johnson controls 2. Trane 3. Siebe-Pritchett, Inc. 4. Siemens Technologies, Landis Division

Rooftop Units Motor Control Centers Volumetric Control	Trane, Carrier, McQuay, Hammer, General Electric, Cambridge (If not under ATC contract)
Domestic WTR Booster Pumps Hot Water Baseboard	Bell and Gosset Bronze Construction Trane without Dampers
Energy Management and Control System	*Invensys-Pritchett*, Trane, and Seimens (No Substitutions)
Underground Storage Tanks	Fuel double wall fiberglass reinforced plastic (FRP) coated (100 mils), double wall welded steel with a primary (internal) tank and a secondary (external) tank; as manufactured by Buffalo Tank Corporation or Adams Tank Corporation; fuel sensor shall be a magnetic probe. Include a quick release filler neck and a watertight raised access to filler neck.
Fuel Storage Monitoring and Leak Detection System	Veeder Root Model TSL-350 (No Equals)
Submersible Fuel Pump	Redjacket (No Equals)

B. Plumbing Equipment Preferences

For plumbing systems, American Standard or Kohler fixtures with Sloan flush valves are recommended. Faucets should be Moen. Provide ball type shut off valves to isolate individual rest room areas and provide access to valves in janitor's closets adjacent to rest rooms.

Provide service valves to enable segmented shutdown of building's water lines. Provide repair kit for any non-standard type plumbing fixtures and faucets.

1.	Water Closets:	Water closets should be floor mounted Sloan flush valve type. Kohler Model #k-4262-ET with 12 inch rough-in water closet is recommended.
2.	Faucets:	Self-closing metering faucets should not be specified unless required by code. Moen, American Standard-Single lever is preferred. (No plastic handles/knobs.)
3.	Flush Valves:	Sloan
4.	Frost Free Hydrants:	Josam, Woodford
5.	Vitreous China Fixtures:	American Standard, Kohler
6.	Garbage Disposals:	Insinkerator (I.E.S.)

7. Cleanouts: Accessible cleanouts should be located in all locker rooms and rest rooms.

8. Valves All valves 2” and smaller should be ball type valves.